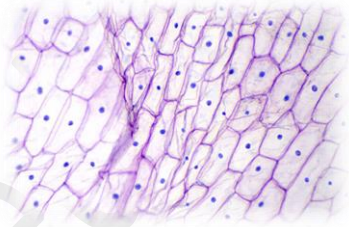
# Unit 1 – Concept 1
# { The cell as a system }

Lesson 1

- The first **system** we will consider is **the cell.**

**Cells**

They are the basic units, or building blocks, of life on Earth.



- Cells are found only in living organisms.
- Cells are very small. We need a microscope to see them.

## Cells function:

- Cells carry out all the functions that organisms need to live, such as:
    1. Growing
    2. Repairing themselves
    3. Reproducing
    4. Responding to the environment

- النظام الأول الذي سننظر فيه هو **الخلية**.
- توجد الخلايا في أجسام الكائنات الحية فقط

الخلايا هي وحدات بناء الكائنات الحية. الخلايا صغيرة للغاية، حيث نحتاج إلى ميكروسكوب لرؤيتها.

### وظيفة الخلايا:

تؤدي جميع الوظائف التي تحتاج إليها الكائنات الحية لتعيش وتشمل تلك الوظائف:

1. النمو
2. تعويض الخلايا التالفة
3. التكاثر
4. الاستجابة للبيئة المحيطة.

## Building Blocks of Living Organisms

***What is the common thing between plants and animals?***


- Both plants and animals are living organisms made of **cells**.
- The cells of plants and animals are different in **shape** and **size**.

### *Cells as Building Blocks*

- Just as the **toy building blocks** can be used to create castles, **cells** are the building blocks that form many different living things.
- A cell is the **smallest basic unit** of life, and it's responsible for all of life's processes.
- Cells are the structural, functional, and biological units of all living beings.

## ما هو الشيء المشترك بين النباتات والحيوانات؟

- كلاهما كائن حي يتكون من عدد من الخلايا.
- تختلف خلايا النبات عن الحيوان في الشكل والحجم.

## الخلية كوحدة البناء

- كما تستخدم المكعبات اللعبة لإنشاء القلاع، فإن الخلايا عبارة عن وحدات تشكل العديد من الكائنات الحية المختلفة.
- الخلية هي أصغر وحدة أساسية للحياة، وهي مسئولة عن جميع العمليات الحيوية.
- الخلايا هي وحدات التركيب، والوظيفة، والحياة لجميع الكائنات الحية.

## *Size of the Cell*

**Most** cells are **very small**

**Some** cells are **very large**

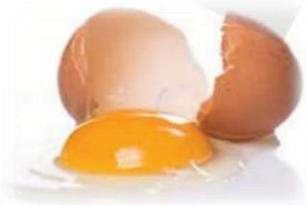
### Examples

- **Common plant or animal cells**
  - They are between 0.005 and 0.1 mm long.
- **Bacteria**
  - They are usually smaller than this.

You will need a microscope to see them.

- **An unfertilized bird egg**
  - It contains only one egg cell.

بيضة الطائر غير المخصبة تحتوي بداخلها على خلية واحدة فقط.



**NOTE:**

- The unaided human eye can see objects that are about 0.1 millimeters (mm) long.

  العين البشرية المجردة يمكنها رؤية الأشياء التي يبلغ طولها ما يقرب من 0.1 ملليمتر.

## Organism Growth and Cells

- Living organisms grow and reproduce by increasing the **number** of cells.
- All new cells come from existing cells.

**نمو الكائن الحي والخلايا**: تنمو الكائنات الحية وتتكاثر، من خلال زيادة عدد خلاياها.

## *Properties (Characteristics) of Cells:*

- Most cells are so small and cannot be seen without a microscope.

**Living organisms are classified according to the number of cells into**

### Unicellular organisms

They are organisms made up of only one cell.

**Ex**: Bacteria

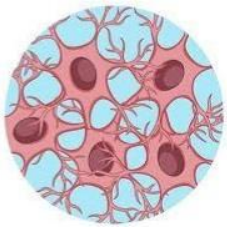
### Multicellular organisms

They are organisms that have more than one cell.

**Ex**: Complex organisms, such as humans, animals and plants.

- Our bodies contain many different kinds of cells with different functions.

Blood Cells



Brain Cells

Muscle Cells

***خصائص (سمات) الخلايا:***

- الخلايا صغيرة للغاية، حيث تحتاج إلى ميكروسكوب لرؤيتها.
- يمكن تقسيم الكائنات الحية من خلال عدد الخلايا إلى نوعين:
  - **كائنات أحادية الخلية** هي الكائنات التي تحتوي على خلية واحدة **مثل** البكتريا.
  - **كائنات متعددة الخلايا** هي الكائنات التي تحتوي على أكثر من خلية واحدة **مثل** الإنسان أو الحيوان أو النبات .
- تحتوي أجسامنا على العديد من الخلايا المختلفة التي تقوم بوظائف مختلفة.

**NOTES:**

- All cells consist of a cell membrane.
- Not all cells have a nucleus, such as red blood cells.
  - جميع الخلايا تتكون من غشاء الخلية.
  - ليست كل الخلايا لديها نواة مثل خلايا الدم الحمراء.

## Cell Needs

- Cells are microscopic building blocks of all living organisms.
- The cell is a **complex** structure that carries out all its own life activities.

## احتياجات الخلية:

- الخلية هي وحدات بناء مجهرية لجميع الكائنات الحية.
- الخلية عبارة عن تركيب معقد تقوم بكل أنشطة حياتها الخاصة.

***Give a reason for:***

- Cells are important.
  - Because cells carry out all the functions that organisms need to live, such as:
    1. Growing
    2. Repairing themselves
    3. Reproducing
    4. Responding to the environment

## *Basic Needs of a Cell*

- The basic needs of a cell are similar to the needs of all organisms, such as:

1 Oxygen gas and food to get energy

2 Water

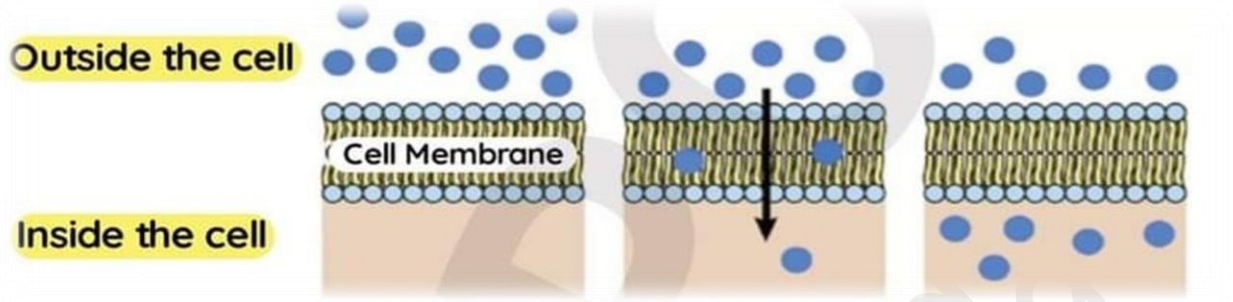
- Cells have a way of **taking in** the needed materials and using them to get energy, grow, and live.
- Cells have a way of **releasing** waste products.

## الاحتياجات الأساسية الخلية:

- تتشابه الاحتياجات الأساسية للخلية في جميع الكائنات الحية وهي:
  1. غاز الأكسجين والغذاء للحصول على الطاقة.
  2. الماء
- الخلايا لها وسيلة لأخذ العناصر اللازمة واستخدامها للحصول على الطاقة والنمو والبقاء.
- الخلايا لها وسيلة للتخلص من الفضلات

# Cell (Plasma) Membrane

➡ It controls (regulates) which substances can enter or leave the cell.




***Give reasons for:***

- The cell membrane allows water to enter the cell.
  - Because water is a basic need for the cell to live.
- The cell membrane allows water to leave the cell.
  - To maintain the proper water balance on both sides of the cell membrane.

***What happens if:***

- Too much water enters the cell.
  - The cell will swell until it bursts.

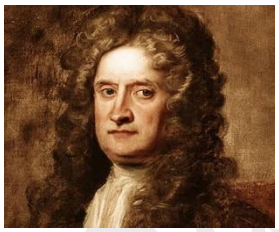
**الغشاء الخلوي:**

- ❖ يتحكم الغشاء الخلوي في المواد التي تدخل أو تخرج من الخلية.
- ❖ يسمح الغشاء الخلوي للماء بالمرور داخل الخلية حيث إن الماء ضروري للحياة.
- ❖ يسمح للماء بالخروج من الخلية وهكذا تكون الخلايا قادرة على الحفاظ على توازن الماء على جانبي الغشاء الخلوي.
- ❖ إذا دخل الكثير من الماء إلى الخلية، فستنتفخ الخلية حتى تنفجر.

Lesson 2

# Brief History of the Cell

## The scientist: Robert Hooke:



- He used the newly invented microscope to observe some too small things to be seen by the unaided eye.
- He looked at samples and described little sections in them.
- He was the first person to use the word "**cell**".

## العالم روبرت هوك

- استخدم الميكروسكوب الذي تم اختراعه حديثا لمراقبة الأشياء الصغيرة جدًّا التي لا يمكن رؤيتها بالعين المجردة.
- فحص هوك بعض العينات ووصف الأجزاء الصغيرة فيها.
- كان هوك أول شخص يستخدم كلمة **خلية** لوصف هذه الصور الدقيقة.

**Improved microscopes** have allowed scientists to make **new discoveries**, **for example**:

The nucleus of a cell was discovered through observation of numerous plant cells.

Later, scientists determined that cells are the basic unit of structure in living things.

**سمحت أجهزة الميكروسكوب المطورة للعلماء باكتشافات جديدة، على سبيل المثال:**

- تم اكتشاف نواة الخلية من خلال مراقبة العديد من الخلايا النباتية.
- وفي وقت لاحق، توصل العلماء إلى أن الخلية الوحدة الأساسية للبناء في الكائنات الحية.

***Give reasons for:***

- Scientists have developed microscopes.
  - To be able to look at small things in more details.
- Scientists used information learned from one another's research.
  - To understand cells better today.

- قام العلماء بتطوير أجهزة الميكروسكوب لرؤية تفاصيل الأشياء متناهية الصغر.
- ساعد ذلك على أن يصبح في إمكان العلماء اليوم استخدام المعلومات المستنتجة من أبحاثهم لفهم الخلايا بشكل أفضل.

***What happens if:***

- The microscope wasn't invented.
  - Scientists would not be able to discover the cell and its structure.

***Hands-on Investigation: Using a Microscope to View Cells***

**Experiment**

- In this activity, you will also make observations and draw what you see when you look at the skin of an onion under a microscope.

***Tools***:

Slice of skin of an onion
شريحة من جلد البصل

Slide of skin of an animal
شريحة من جلد الحيوان


Distilled water
مياه مقطرة

Compound microscope
المجهر المركب

Eyedropper
قطّارة

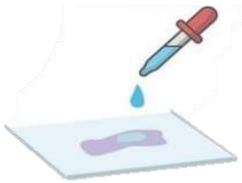
Glass slide
شريحة زجاجية

Coverslip
غطاء شريحة

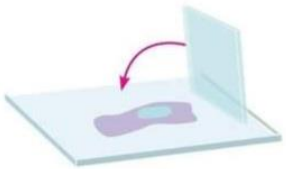
***Steps:***

1) Place the thin membrane of an onion in the center of a glass slide.
ضع الغشاء الرقيق للبصلة في وسط شريحة زجاجية

2) Add 3 drops of distilled water to it.
أضف 3 قطرات من الماء المقطر إليها



3) Carefully place the coverslip over it.
ضع بحذر غطاء الشريحة فوقه

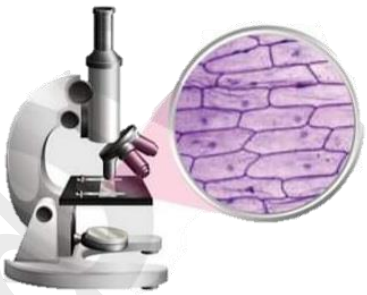


4) Examine the sample under the compound microscope.
افحص العينة تحت المجهر المركب

5) Repeat the previous steps on a slide of skin of an animal.
كرر الخطوات السابقة على شريحة من جلد الحيوان.

***Observations:***

- The samples of an onion and an animal consist of small units known as cells.
- The shape of the cells is different for the two samples.
- Each cell contains many components.



- تتكون عينات البصل والحيوان من وحدات صغيرة تعرف بالخلايا.
- شكل الخلايا مختلف للعينتين.
- كل خلية تحتوي على العديد من المكونات.

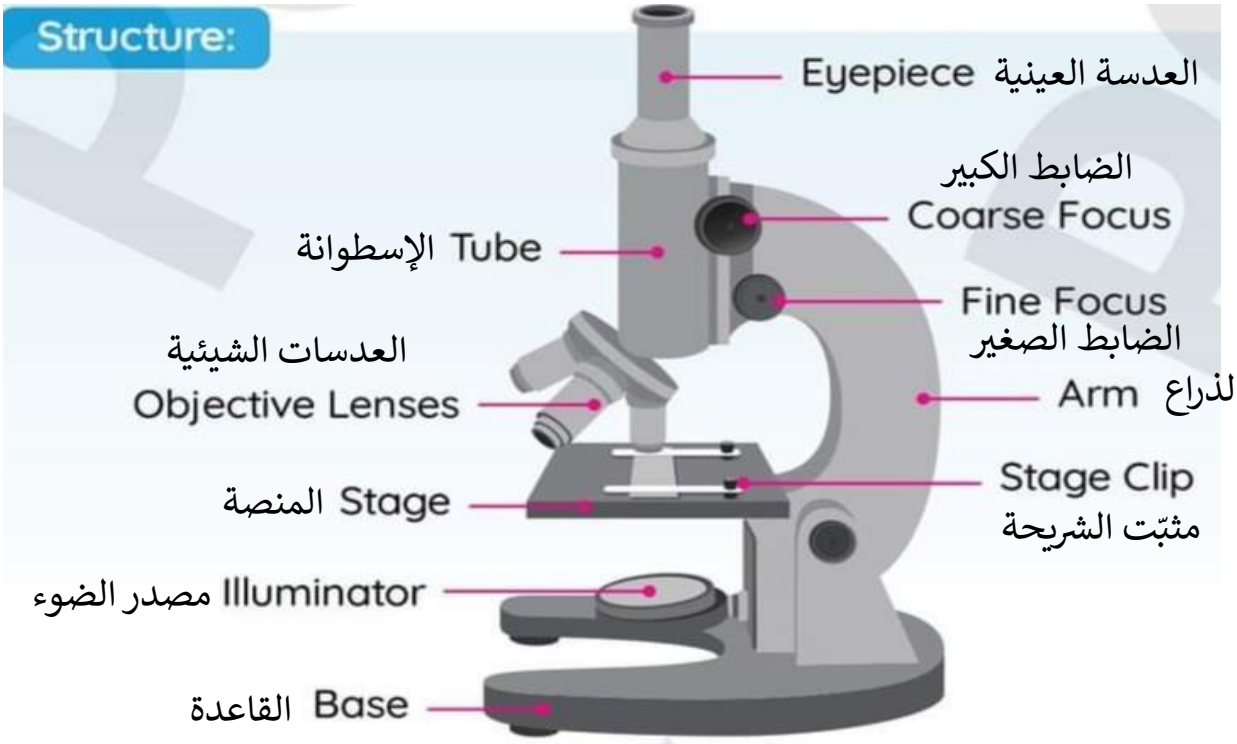
***Conclusion:***

- Cells are the smallest building units that form different living organisms.
الخلايا هي أصغر الوحدات البنائية التي تكوّن كائنات حية مختلفة.

## *Compound Microscope*

### *Importance*

- It magnifies cells that can't be seen by the unaided eye.
يكبّر الخلايا التي لا يمكن رؤيتها بالعين المجردة.




## ***Steps of using the microscope:***


1) Place the microscope slide on the **stage** and secure it with the **stage clips**.
2) Pick up the lowest-power **objective lens**.
3) Look at the slide through the **eyepiece** while adjusting the focusing knobs to get more clear view of the specimen.
4) Clean up the slide and store the microscope safely when you are finished.

## خطوات استخدام المجهر (الميكروسكوب) :

1. ضع شريحة الميكروسكوب على **المنصة** وثبّتها **بمثبت الشريحة**.
2. التقط **العدسة الشيئية** ذات الطاقة الأقل.
3. انظر إلى الشريحة من خلال **العدسة العينية** أثناء ضبط مقابض التركيز للحصول على رؤية أكثر وضوحا للعينة.
4. قم بتنظيف الشريحة وخزّن الميكروسكوب بشكل آمن عندما تنتهي.

**NOTE:**

- You can change the magnifying power by changing the objective lens. (Focal length)

  يمكن تغيير قوة التكبير عن طريق تغيير العدسة الشيئية (البعد البؤري)

## Lesson 3 The Parts of a Cell

***Living organisms are classified according to the number of cells into:***

تصنّف الكائنات الحية حسب عدد الخلايا إلى:

### *Unicellular organisms*

- They are organisms made up of only one cell.

**Ex:** Bacteria

- The number of cells in living organisms varies.

**الكائنات الحية وحيدة الخلية :**

- هي كائنات حية تتكون من خلية واحدة فقط.

**مثل:** البكتيريا

- يختلف عدد الخلايا في الكائنات الحية.

### *Multicellular organisms*

- They are organisms that have more than one cell.

**Ex:** Complex organisms such as humans, animals, and plants.

**الكائنات عديدة الخلايا:**

- هي كائنات حية تحتوي على أكثر من خلية واحدة.

**مثل:** الكائنات المعقدة مثل الإنسان والحيوانات والنباتات.

***The number of cells in living organisms varies, as follow:***

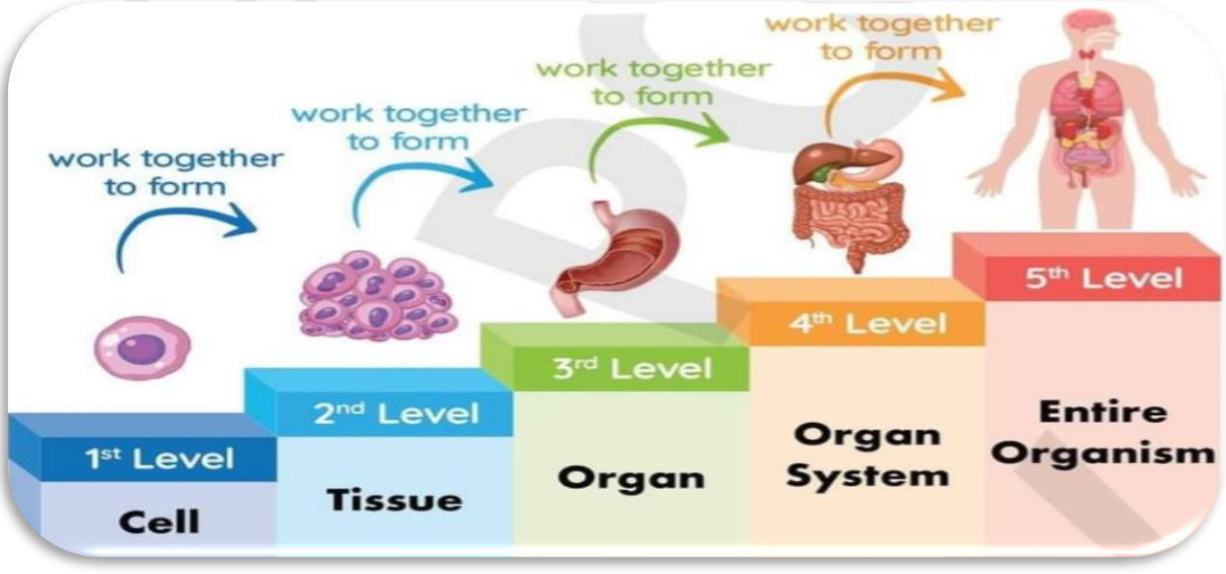
| Human | Animal | Plant |
|---|---|---|
| A human has about 40 trillion cells. | An animal has a variety of cell types, including:<br>• Muscle cells<br>• Bone cells<br>• Blood cells | A plant has a variety of cell types that perform photosynthesis or collect water and mineral nutrients. |

***يختلف عدد الخلايا في جميع الكائنات الحية***

- يملك الإنسان ما يقرب من ٤٠ تريليون خلية.
- للحيوانات مجموعة متنوعة من الخلايا، بما في ذلك خلايا العضلات، وخلايا العظام، وخلايا الدم.
- تقوم الأنواع المتخصصة من الخلايا النباتية بعملية البناء الضوئي، أو تجميع المياه والعناصر الغذائية.

## *Levels of Biological Organization*

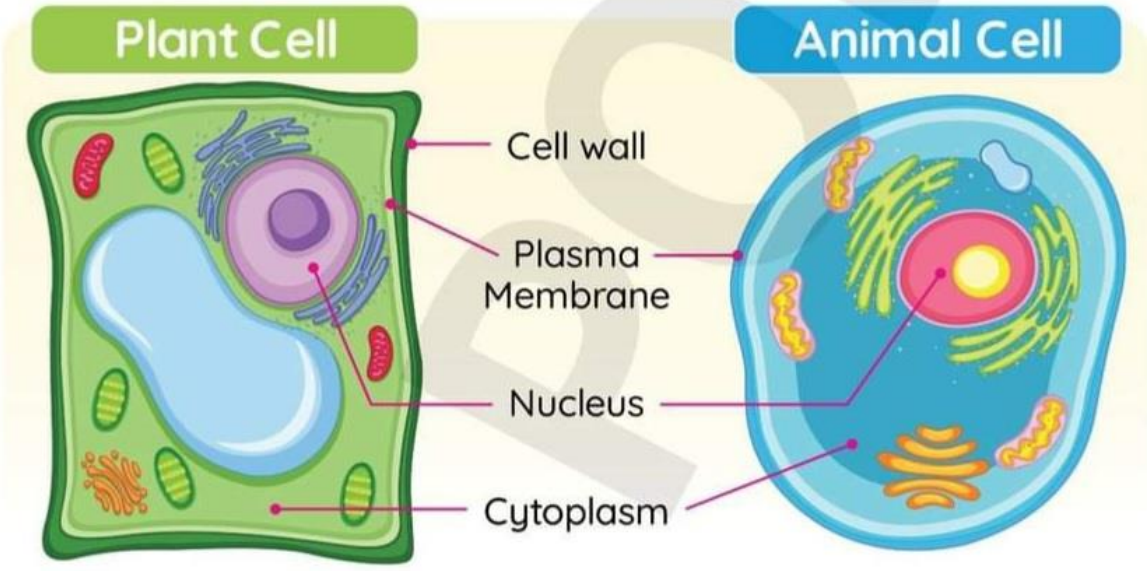
- The structure of most multicellular organisms is organized into **five levels**:



- Each level plays a specific role related to that organism's structure and function.

| Level | Definition | Examples |
|---|---|---|
| **Cell** | The basic (smallest) unit of life. | Stomach cells |
| **Tissue** | A group of similar cells that share a common origin and perform the same function. | Stomach tissues |
| **Organ** | A group of tissues involved in performing a particular function. | Stomach |
| **System** | A group of organs that perform a specific function. | Digestive system |
| **Entire organism** | A group of systems that work together. | Human |

## *Structure of the Cell*



- Now, we are going to study some parts of the cell and their functions:

والآن سوف ندرس بعض أجزاء الخلية ووظائفها:

## Cell wall

**جدار الخلية:**

- **الموقع**: يحيط بالخلية النباتية من الخارج.
- **الوظيفة**: إعطاء الخلية شكلا محددا.

- **Location:** It surrounds the plant cell from outside.
- **Function:** It gives the cell a definite shape.

## Plasma (Cell) Membrane

**غشاء الخلية:**

- **الموقع:** يحيط بالخلية (السيتوبلازم).
- **الوظيفة:** يحمي الخلية وينظم ما يدخل إليها أو يخرج منها.

- **Location**: It surrounds the cell (cytoplasm).
- **Function**: It protects the cell and regulates what can enter or leave it.

## Nucleus

**النواة:**

- **الموقع**: تقع في وسط الخلية.
- **الوظيفة**: مركز التحكم في العضيات.

- **Location**: It is located at the center of the cells.
- **Function**: It is the control center for the organelles.

## Cytoplasm

**السيتوبلازم:**

- **الموقع**: يقع داخل الغشاء.
- **الوظيفة**: يدعم الخلايا.

- **Location**: It is located inside the membrane.
- **Function**: It supports the organelles.

## Organelle

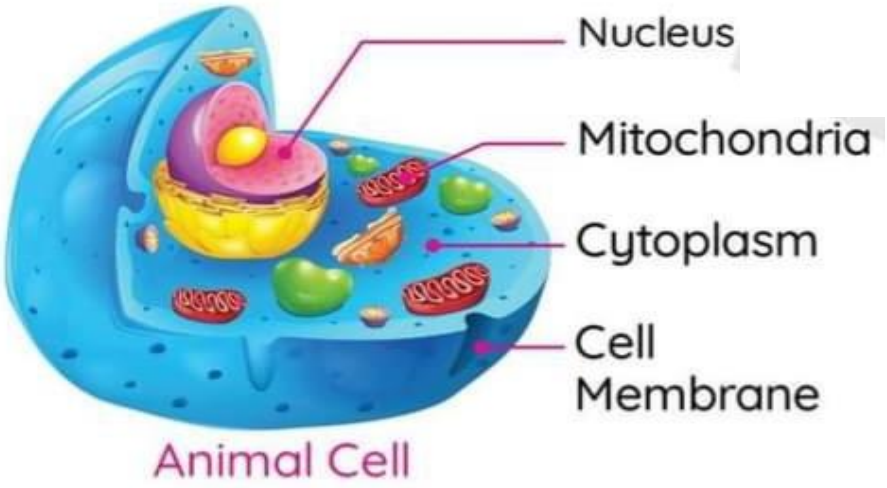
- It's a structure within the cell that has a special function.
العضية: هو تركيب داخل الخلية له ووظيفة خاصة.

## *The Functions of Cell Parts*

- Different cells have different structures.
- The cells of multicellular organisms can vary greatly.

### *Common characteristics:*

- Most cells have cytoplasm, a cell membrane, a nucleus, and mitochondria.




### *Cell Membrane*

- It is the outer lining of the cell.
- It controls which substances can enter or leave the cell.
- It is said to be "**selectively permeable**." Because some substances can pass through it, while others cannot.

### *Cytoplasm*

- It is the **gelatinous** liquid inside the cells in which other cell parts float.

## *Nucleus*

- It is responsible for controlling cell activities, such as:
  1) Making proteins  2) Cell division

## *Mitochondria*

- They are powerhouses that supply the cell with energy.
- Cellular respiration takes place in it.

  **Cellular respiration:**
  - It's a process of using oxygen gas to get chemical energy from food.

### *الغشاء الخلوي:*

- هو البطانة الخارجية للخلية.
- يساعد على التحكم في المواد التي يمكن أن تدخل إلى الخلية أو تخرج منها.
- يقال إن الغشاء الخلوي: " **انتقائي النفاذية** " لأن بعض المواد يمكن أن تمر من خلاله، بينما يمنع البعض الآخر.

### *السيتوبلازم:*

- هو سائل **هلامي** داخل الخلايا والذي تطفو فيه مكونات الخلية الأخرى.

### *النواة:*

- مسئولة عن التحكم في أنشطة الخلية مثل:

1) تكوين البروتينات  2) الانقسام لتكوين خلايا جديدة.

### *الميتوكوندريا:*

- هي مراكز الطاقة للخلية.
- يحدث التنفس الخلوي في الميتوكوندريا.

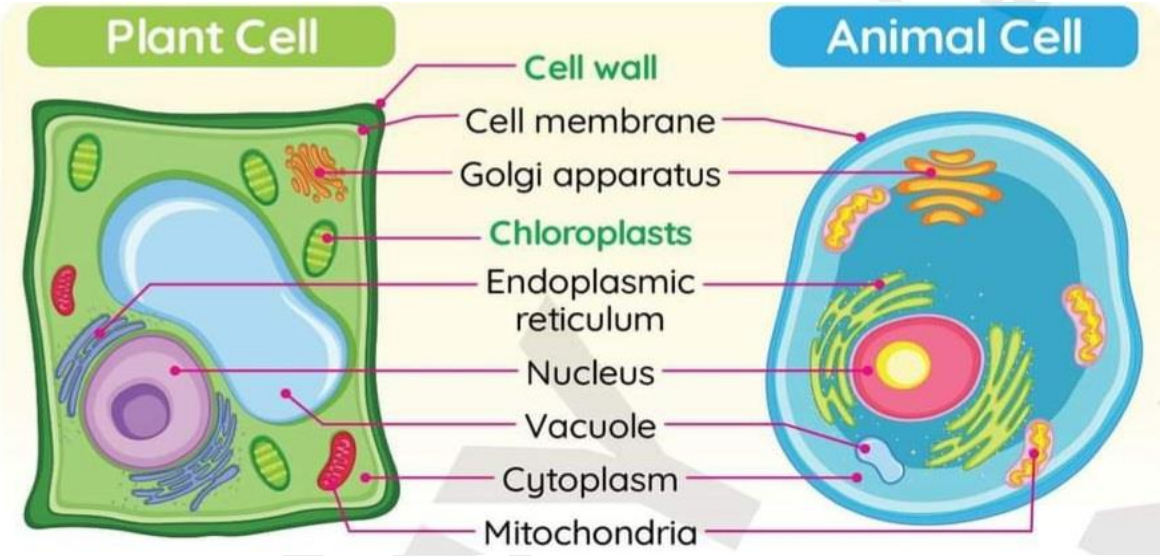
### التنفس الخلوي:

- هو عملية استخدام الأكسجين للحصول على الطاقة من الغذاء.

## Lesson 4 Comparing Plant and Animal Cells

- Plant cells and animal cells have **similarities** and **differences**.
- The following two figures represent the structure of each cell.

- الخلايا النباتية والحيوانية لديها أوجه تشابه واختلاف.
- يمثل الشكلان التاليان تركيب كل خلية.



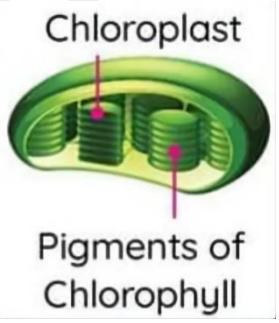

| P.O.C | Animal cells<br>الخلية الحيوانية | Plant cells<br>الخلية النباتية |
|---|---|---|
| **Differences** | They don't have a cell wall or chloroplast.<br>ليس لديها جدار خلوي أو بلاستيدة خضراء | They have a cell wall and a chloroplast.<br>لديها جدار خلوي وبلاستيدة خضراء |
| **Similarities** | Both of them have common organelles, such as:<br>1)Cell membrane 2) Cytoplasm<br>3) Nucleus 4) Mitochondria<br>5) Endoplasmic reticulum<br>6) Golgi apparatus 7) Vacuole | |

| | |
|---|---|
| كلاهما لديه عضيات مشتركة مثل:<br>1)غشاء الخلية 2) السيتوبلازم<br>3) النواة 4) الميتوكوندريا<br>5) الشبكة الإندوبلازمية<br>6) جهاز جولجي 7) الفجوات | |

## Differences Between Plants and Animals

### Plants

- Under the microscope, the plant cell has tiny grains.
- These grains are green.
  - Because they contain the pigment of chlorophyll.




**How does the plant make its own food?**

1. The **pigment chlorophyll** absorbs energy from sunlight.
2. The **chloroplast** uses energy to make food for the plant.

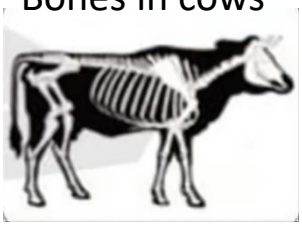
- إذا نظرت إلى الخلية النباتية تحت الميكروسكوب، فيمكنك رؤية أنها تحتوي على حبيبات صغيرة خضراء في أكياس.
- تتكون ورقة النبات من بلاستيدات تحتوي على حبيبات خضراء تسمى صبغة الكلوروفيل .
- هذه الحبيبات خضراء لأنها تحتوي على صبغة الكلوروفيل.

**كيف يتمكن النبات من صنع غذائه بنفسه ؟**

- تمتص **صبغة الكلوروفيل** الطاقة من ضوء الشمس
- تستخدم **البلاستيدات الخضراء** تلك الطاقة لصنع غذاء النبات.

## ***Animals***

Bones in cows

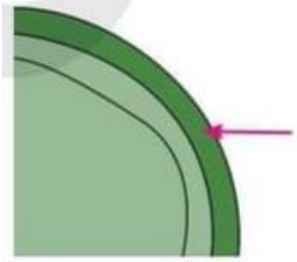


- Animal cells do not have **chloroplasts** or a **cell wall**.
- **Animals can't make their own food.**
  - Because they don't have **chloroplasts**.
- **Animals do not take on the rigid structures that plants do.**
  - Because they don't have **cell walls**.


- Animals have other ways of keeping their shape.
  - Some animals have **bones**.
  - Insects have an **exoskeleton** (a hard, shell-like covering).

- لا تحتوي الخلايا الحيوانية على **بلاستيدات خضراء** أو **جدار خلوي**.
- **لا تتمكن الحيوانات من صنع غذائها بنفسها**
  - لعدم وجود بلاستيدات خضراء في خلاياها.
- **لا تتخذ الحيوانات نفس الهياكل التي تتخذها النباتات**
  - لأن الخلايا الحيوانية لا تحتوي على جدار خلوي.
- لدى الحيوانات طرق أخرى للحفاظ على شكلها.
  - بعض الحيوانات لديها **عظام**
  - والبعض الآخر مثل: الحشرات لها ظهر صلب يشبه الصدقة يسمى **الهيكل الخارجي**

## ***First:*** Different cell organelles:

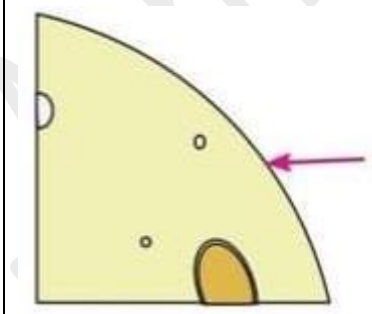
| Organelle | Illustration | Function |
|---|---|---|
| **Cell Wall** |  | ✚ It is found in the plant's cell only.<br>✚ It's the rigid outside material that surrounds the plant cells.<br>✚ It gives them a definite shape.<br>جدار الخلية:<br>- توجد في النباتات فقط.<br>- هي المادة الخارجية الصلبة التي تحيط بخلايا النبات.<br>- تعطي النبات شكلا محددا. |
| **Chloroplast** |  | ✚ It is found in the plant's cell only.<br>✚ It contains chlorophyll and carries out the **photosynthesis process**.<br>**البلاستيدة الخضراء:**<br>- توجد في النباتات فقط.<br>- تحتوي على مادة الكلوروفيل وتقوم بعملية البناء الضوئي. |

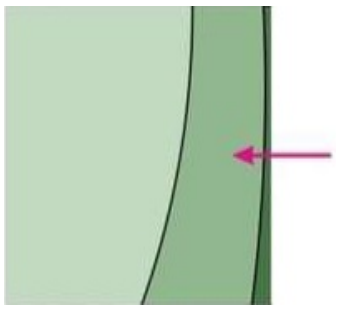
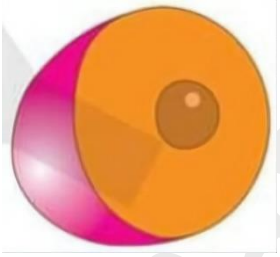
## *Second*: Common cell organelles:

→ Both plant and animal cells have common organelles to **control**, **organize**, and **maintain** the cell.

→ These functions are mainly done by the **cell membrane**, **cytoplasm**, **cell nucleus**, **mitochondria**, **endoplasmic reticulum**, **Golgi apparatus**, and **vacuole**.

- تحتوي كل من الخلايا النباتية والحيوانية على عضيات مشتركة للتحكم في الخلية وتنظيمها والحفاظ عليها.
- تتم هذه الوظائف بشكل رئيسي عن طريق غشاء الخلية، السيتوبلازم، نواة الخلية، الميتوكوندريا، الشبكة الإندوبلازمية، جهاز جولجي، و الفجوة.

| Organelle | Illustration | Function |
|---|---|---|
| **Cell membrane** |  | ✚ It is the surrounding layer of the cell.<br>✚ It controls what materials enter and leave the cell.<br>**غشاء الخلية:**<br>- الطبقة المحيطة بالخلية التي تتحكم في المواد التي تدخل إلى الخلية وتخرج منها. |

| | | |
|---|---|---|
| **Cytoplasm** |  | ✚ It is the **gelatinous liquid** inside the cells in which other cell parts float.<br>**السيتوبلازم:**<br>- هو السائل الهلامي داخل الخلايا والذي تطفو فيه مكونات الخلية الأخرى. |
| **Cell Nucleus** |  | ✚ It controls the functions inside the cell, such as:<br>1. Making proteins<br>2. Cell division<br>**نواة الخلية:**<br>- تتحكم النواة في الوظائف داخل الخلية مثل: إنتاج البروتين، وانقسام الخلية |
| **Mitochondria** |  | ✚ It converts **sugar** into **energy** for the cell.<br>**الميتوكوندريا:**<br>تحول السكر إلى طاقة للخلية. |
| **Endoplasmic Reticulum** |  | ✚ It helps in **assembling** and **transporting** proteins.<br>**الشبكة الإندوبلازمية:**<br>- تساعد في جمع ونقل البروتينات. |

| | | |
|---|---|---|
| **Golgi Apparatus** |  | ✚ It helps **package** nutrients within vital products inside the cell.<br>✚ It helps **transport** nutrients outside the cell.<br>**جهاز جولجي:**<br>- يساعد على تعبئة وتغليف العناصر الغذائية داخل الخلية.<br>- يساعد على نقل المواد الغذائية خارج الخلية. |
| **Vacuole** |  | ✚ They are **saclike** structures used for the storage of nutrients, water, and waste.<br>✚ In plant cells, large vacuoles contain water.<br>**الفجوة العصارية:**<br>- تركيب يشبه الكيس ويستخدم لتخزين العناصر الغذائية والمياه والفضلات.<br>- في الخلايا النباتية تحتوي الفجوات الكبيرة على الماء. |

***Give reason for:***

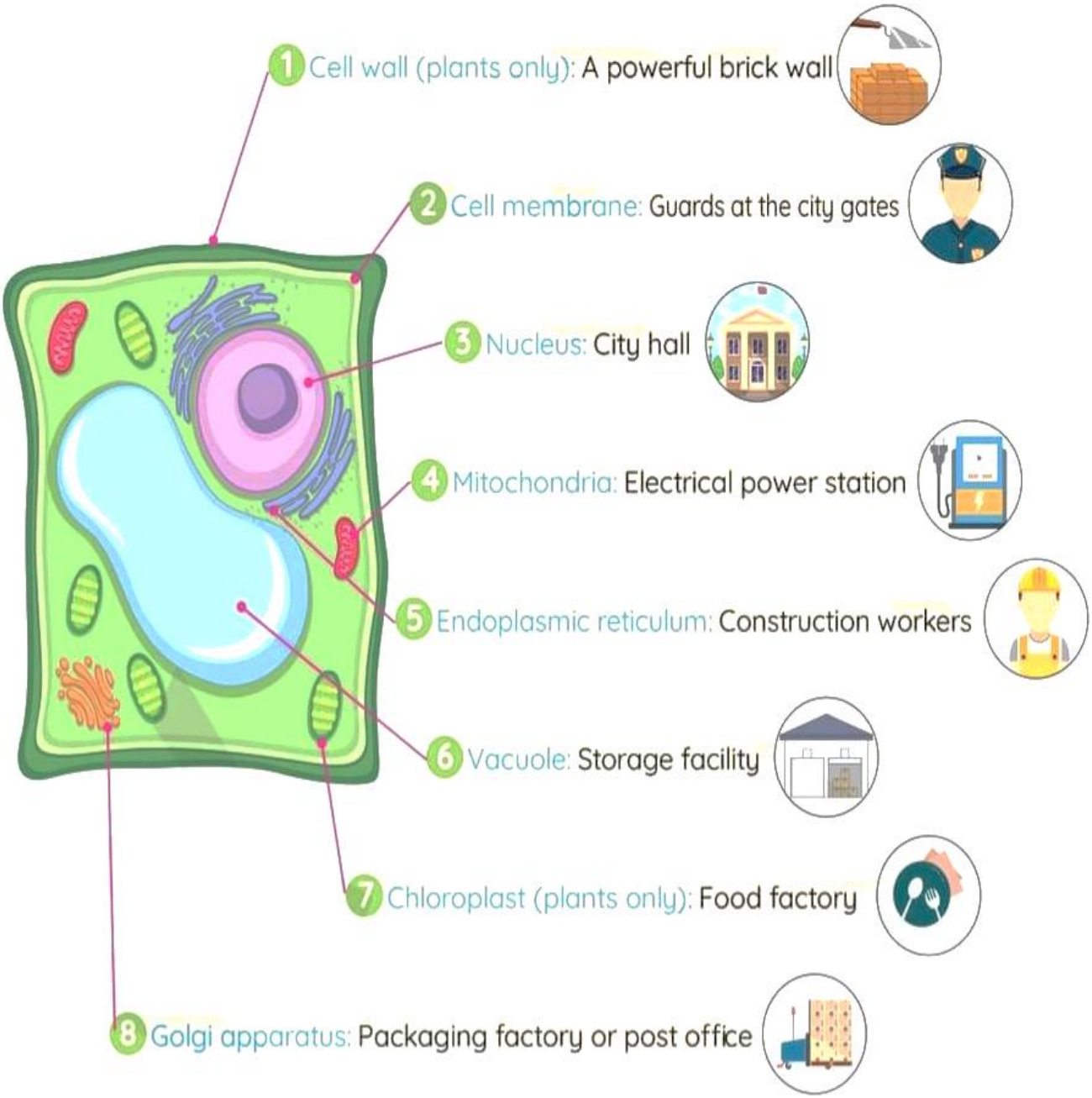
- The vacuole is larger in the plant cell than in the animal cell.
  - Because the plant stores a large amount of water in the vacuole.

## ***Planning a Cell City***

- Suppose you are an engineer, and you have been asked to design a cell city model to display different organelles.

**التخطيط لمدينة الخلية:**

- لنفترض أنك مهندس، وقد طلب منك تصميم نموذج لمدينة خلوية لعرض العضيات المختلفة.



1) الجدار الخلوي ( في النباتات فقط): جدار قوي من الطوب.
2) الغشاء الخلوي: حراس بوابات المدينة.
3) النواة: مجلس إدارة المدينة.
4) الميتوكوندريا: محطة توليد الكهرباء
5) الشبكة الإندوبلازمية: عمال البناء.
6) الفجوة العصارية: صومعة التخزين
7) البلاستيدة الخضراء (في النباتات فقط): مصنع الغذاء.
8) جهاز جولجي: مصنع التعبئة أو مكتب البريد.

- ***There are two structures in plant cell that are not found in the animal cell, which are:***
  1. The stone wall surrounding the city (that represents the **cell wall**).
  2. The food factory (that represents the **chloroplast**).

**هناك تركيبان في الخلية النباتية لا يوجدان في الخلية الحيوانية، وهما:**

- السور الحجري المحيط بالمدينة (الذي يمثل **جدار الخلية**).
- مصنع الغذاء (الذي يمثل **البلاستيدات الخضراء**).

## Lesson 5 & 6 Careers and Cell Biology

- Cells are very tiny, where the diameter of an animal cell is about (0.001 cm).

***Cell biologists*** **are scientists who study cells.**

- Cell biologists use microscopes to magnify cells, so they seem larger.

- ***Cell biologists work in laboratories and do experiments to study:***
  - How cells work inside the living organisms.
  - How cells respond to different variables.

**وظائف وبيولوجيا الخلية:**

- الخلايا صغيرة جدًا حيث يبلغ قطر الخلية الحيوانية حوالي (0.001 سم).

**علماء الأحياء الخلوية هم العلماء الذين يدرسون الخلايا.**

- يستخدم علماء الأحياء الخلوية المجاهر لتكبير الخلايا بحيث تبدو أكبر.

- ***يعمل علماء الأحياء الخلوية في المختبرات ويقومون بتجارب لدراسة:***
  - كيفية عمل الخلايا داخل الكائنات الحية.
  - كيف تستجيب الخلايا للمتغيرات المختلفة.

**Cell biologists analyze data and present their conclusions to other researchers, where:**

يقوم علماء الأحياء الخلوية بتحليل البيانات وتقديم استنتاجاتهم إلى باحثين آخرين، حيث:

Some cell biologists work with doctors to watch how cells can work to repair body parts or how cells respond to different medicines.

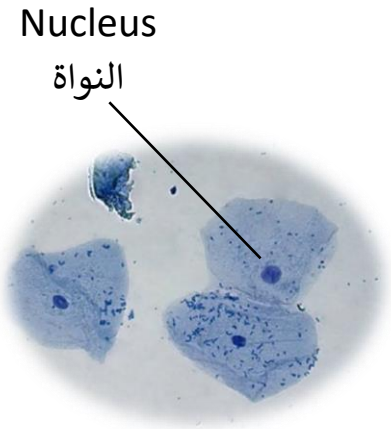
يعمل بعض علماء الأحياء الخلوية مع الأطباء لمراقبة كيفية عمل الخلايا لإصلاح أجزاء الجسم أو كيفية استجابة الخلايا للأدوية المختلفة.

Some other cell biologists work in agriculture to study how plant cells respond to different environmental factors.

يعمل بعض علماء الأحياء الخلوية الآخرين في الزراعة لدراسة كيفية استجابة الخلايا النباتية للعوامل البيئية المختلفة.

## Staining Cells:

- Cells are usually clear and colorless, so it is hard to see their structures under microscope.
- Stains (dyes) are used to add color and make the cell's structures more visible.




Cheek cells under microscope
خلايا الخد تحت المجهر

- There are different types of stains, where some stains are used to highlight one part of cells and make it more visible such as "**methylene blue**" dye that helps you see the nucleus as a blue area in a sample of cheek lined membrane cells.

### تلطيخ الخلايا:

- الخلايا عادة ما تكون واضحة وعديمة اللون، لذلك من الصعب رؤية بنيتها تحت المجهر.
- تستخدم البقع (الأصباغ) لإضافة اللون وجعل هياكل الخلية أكثر وضوحا.
- هناك أنواع مختلفة من البقع، حيث تستخدم بعض البقع لإبراز جزء واحد من الخلايا وجعله أكثر وضوحا مثل صبغة "أزرق الميثيلين" التي تساعدك على رؤية النواة كمنطقة زرقاء في عينة من خلايا الغشاء المبطن بالخد.

## Cells in 3D

Scientists have built a microscope that shows the cell in 3D, which means that they can see the top, sides and layers of a cell, where :

The 3D microscope takes pictures of a cell in layers.

Then, a computer puts these layers together.

Finally, colors are added to the formed image.

**The 3D microscope can help:**

- Cell biologists learn more about cell components.
- Doctors to treat cancer which is caused by cells that divide too quickly.

**الخلايا ثلاثية الأبعاد:**

قام العلماء ببناء مجهر يظهر الخلية بشكل ثلاثي الأبعاد، مما يعني أنهم يستطيعون رؤية أعلى وجوانب وطبقات الخلية، حيث:

- يلتقط المجهر ثلاثي الأبعاد صوراً للخلية على شكل طبقات.
- ثم يقوم الكمبيوتر بتجميع هذه الطبقات معًا.
- وأخيرا، يتم إضافة الألوان إلى الصورة المشكلة.

يمكن أن يساعد المجهر ثلاثي الأبعاد في:

- يتعلم علماء الأحياء الخلوية المزيد عن مكونات الخلية
- الأطباء يعالجون السرطان الذي يسببه انقسام الخلايا بسرعة كبيرة.

# Unit 1 – concept 1 – questions

## Lesson 1

## Choose the correct answer:

1) The …… is the building unit of a living organism's body.
   a. brick  b. cell  c. organ  d. blood

2) Humans are …….. organisms.
   a. unicellular  c. multicellular
   b. prokaryote  d. simple

3) An unaided human eye can see an object …… millimeters long.
   a. 0.01  b. 0.005  c. 0.5  d. 0.001

4) An unaided human eye can't see all the following, except ……..
   a. an onion's cell  c. a bacterial cell
   b. a skin's cell  d. a bird's unfertilized egg cell

5) A living organism grows and reproduces by increasing the ……. of its body cells.
   a. number  b. size  c. volume  d. length

6) All the following are multicellular living organisms, except ……..
   a. a bean plant  b. a cat  c. bacteria  d. a human

7) All the following are from the basic needs for the cell, except …….
   a. Water  b. oxygen  c. food  d. carbon dioxide

8) The …… regulates the substances that pass in or out of the cell.

a. Nucleus c. cell wall
b. plasma membrane d. cytoplasm

9) Which statement about the cells is false?

a. All living organisms are composed of cells.
b. All cells come from existing cells.
c. Most cells are microscopic in size.
d. All cells have a nucleus.

## ***Put (√) or (X):***

1- Most cells are usually very small. ( )

2- The unaided human eye can see a bacteria cell. ( )

3- Different living organisms have similar cells that have similar functions. ( )

4- Increasing the number of the living organism's cells occurs during reproduction process only. ( )

5- The cell membrane allows water to enter the cell, but not to leave it. ( )

6- There must be a water imbalance at the two sides of the cell membrane, so that the cell won't burst. ( )

7- The cell membrane allows only the needed substances to enter the cell. ( )

8- Scientists can use a telescope to see the very small cells. ( )

9- An unfertilized bird egg contains more than one egg cell.

( )

10- Multicellular organisms consist of only one single cell, such as the plant cell. ( )

## ***Write the scientific term:***

1. They are the building units of life on Earth. ( …….. )
2. They are living organisms, and their bodies consist of more than one cell. ( …….. )
3. They are living organisms, and their bodies consist of only one cell. ( …….. )
4. It's a device used to see very small cells as a plant cell. ( …….. )
5. It controls the substances that enter or leave the cell. ( …… )
6. It's a gas which the cell needs to get energy and perform its vital activities. ( …….. )
7. They're materials released from the cell. ( ……. )
8. It's a liquid material that is necessary for the cell to do its function well. ( …… )

## ***Complete the following sentences using the words between the brackets:***

( **nucleus - shape – oxygen - energy - cell membrane – size – waste products – food**)

1) Cells in our body are different in …….. and ……. because they have different functions.
2) All cells are composed of a ……. .
3) A cell takes in …… and …….. to get …… but it releases
4) Not all cells contain ……

## ***Correct the underlined words:***

1- Most cells are very **large**, so we can see them with our naked eyes. ( …… )

2- A cell is a **simple** structure that carries out its vital activities. ( ……. )

3- Bacteria are **multicellular** living organisms. ( …….. )

4- Living organisms can be divided into multicellular and unicellular organisms according to the **size** of cells in their bodies. ( …… )

5- The cell will **shrink** when too much water keeps entering it. ( …….. )

## ***Cross out the odd word:***

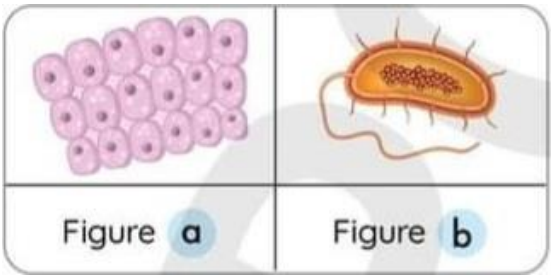
a) Plant - Bacteria - Animal - Human
b) A skin cell - A plant cell - An animal's cell - A bird's unfertilized egg cell
c) Oxygen Water - Carbon dioxide - Food

## ***Choose from column (A) what suits it in column (B):***

| Column (A) | Column (B) |
|---|---|
| 1. A cell membrane<br>2. A bird's unfertilized egg cell<br>3. Bacterium<br>4. A skin cell | a. is smaller than 0.005 mm long.<br>b. length ranges between 0.005 to 0.1 mm.<br>c. controls the amount of water that enters the cell.<br>d. is a very large cell. |

## ***Study the following figures, then complete the sentences below:***

1) Figure …… represents a bacterial cell, as it consists of …….. cell(s).
2) Figure …… represents the cells of a human skin.



## ***Give reasons for:***

1. The cell provides the structure of the living organism's body.

……

……

2. A plant is considered a multicellular organism.

……

……

3. Bacteria are considered unicellular organisms.

……

……

4. You can see a bird's unfertilized egg, but you can't see your skin cell without a microscope.

……

……

5. The cell membrane is very important for the cell.

……

……

6. The cells of the same living organisms are different in shape and size.

……

……

7. The amount of water must be balanced at the two sides of the cell membrane.

……

……

## ***What happens if:***

1- The cell can't get its basic needs.

……

……

2- The cell membrane is absent in an animal cell.

……

……

3- Too much water enters the cell.

……

……

## ***Lesson 2***

## ***Choose the correct answer:***

1) …… was the first scientist to use the word "cell".
   a. Newton  b. Hooke  c. Edison  d. Einstein

2) The nucleus was discovered during an observation of an enormous …… cell.
   a. animal  b. bacterial  c. human  d. plant

3) Scientists concluded that the …….. is the basic unit of the organism's structure.

a. cell b. organ c. tissue d. system

4) All the following are form the parts of a compound microscope, except the ……..

a. eyepiece c. illuminator
b. objective lenses d. objective mirrors

5) The membrane of an onion consists of similar units called ……

a. cells b. nuclei c. organs d. tissues

6) You can change the power of magnifying of a microscope by using another ……..

a. objective lens b. eyepiece c. mirror d. arm

## ***Put (√) or (X):***

1. Developed microscopes have allowed scientists to make new discoveries. ( )
2. Sometimes a single cell exists on its own as in bacteria. ( )
3. The membrane of an onion consists of different units called cells. ( )
4. The cell in an onion membrane contains many components. ( )
5. A leaf cell and a red blood cell can exist in the same organism. ( )
6. Scientists must be open to new ideas about how cells work. ( )

## ***Write the scientific term:***

1- It's a device that can be used to magnify cells.

( …… )

2- They're the identical building units of living organisms.

( …….. )

3- It's the type of water added on the samples in microscopes.

( …….. )

4- It's a part of the microscope through which you look at the sample. ( …….. )

5- It's a part of the microscope that changes the magnifying power. ( …… )

## ***Correct the underlined words:***

I. A complex living system contains **one cell**.

( …….. )

II. We use drops of **tap** water on the sample in a microscope. ( …… )

III. We look at the sample through the **objective lens** of the microscope. ( …… )

IV. We change the magnifying power of the microscope by using a different **mirror**. ( …….. )

## ***Cross out the odd word:***

- ❖ Objective lens - Stage clips - Eyepiece - Distilled water
- ❖ A leaf cell - A red blood cell - A skin cell - A bird's unfertilized egg cell

## ***Choose from column (A) what suits it in column (B):***

| Column (A) | Column (B) |
|---|---|
| 1) The cell<br>2) A compound microscope<br>3) Changing the objective lens | a) changes the magnifying power of the microscope.<br>b) is the building unit of the living organism's structure.<br>c) can be used to examine a thin membrane of an onion. |

## ***Answer the following questions:***

**Study the following three figures that represent the samples under a compound microscope, then put true or false:**

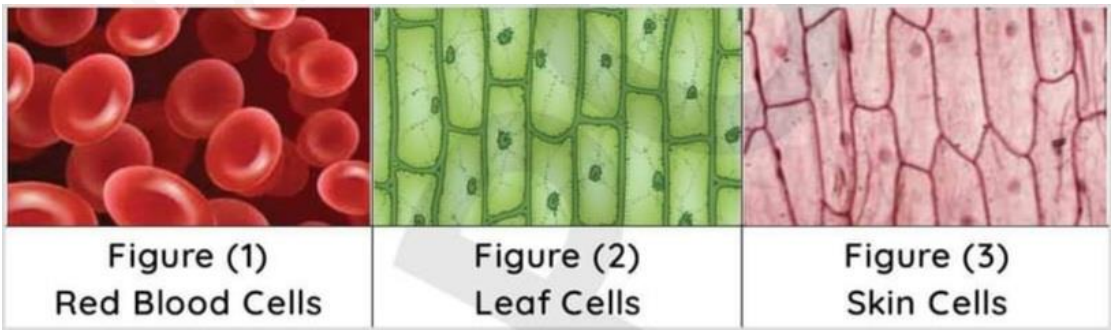


Figure (1) Red Blood Cells | Figure (2) Leaf Cells | Figure (3) Skin Cells

1. All the three samples represent microscopic cells. (  )
2. The three samples have different functions. (  )

3. All the three samples can exist in the same organism.
( )
4. Each figure represents the basic units that form an organism. ( )

**The following diagram represents the** ……

**Write the following labels:**

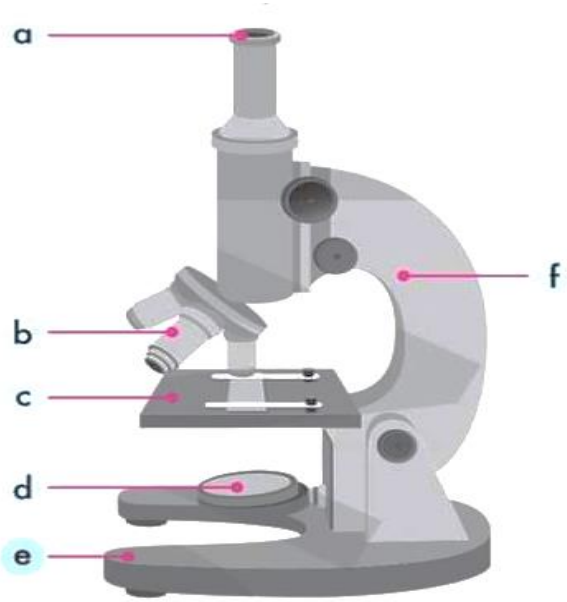
**a)** ……

**b)** ……

**c)** ……

**d)** ……

**e)** ……




## ***Give a reason for:***

The microscope is very important for the biologists and botanists.

……

……

## ***What happens if:***

The microscope wasn't invented.

……

……

## ***Lesson 3***

## ***Choose the correct answer:***

1) The human body is composed of ……cells.
   a. 40 hundred  b. 40 thousand  c. 40 million  d. 40 trillion

2) All the following are from the cells found in the animal body, except the ……
   a. blood cells  c. bone cells
   b. xylem cells  d. muscle cells

3) A/An …… is a unicellular simple living organism.
   a. human  b. animal  c. bacterium  d. plant

4) The tissue is a set of similar ……
   a. systems  b. cells  c. organs  d. organelles

5) All the following are considered organs, except the ……..
   a. lung  b. heart  c. stomach  d. muscle tissue

6) The systems that keep a multicellular organism alive are divided into …… levels.
   a. two  b. three  c. four  d. five

7) All the following organelles are common in plants and animals cells, except the ……
   a. cytoplasm  c. nucleus
   b. cell wall  d. cell membrane

8) Cell's components are suspended in the ……..
   a. Nucleus  c. cytoplasm
   b. cell wall  d. cell membrane

9) The ……. surrounds the plant cell from outside and gives it a definite shape.

a. Nucleus c. cytoplasm
b. cell wall d. cell membrane

10) The …….. is a liquid that fills the cavity of the cell and is surrounded by the cell membrane.

a. Nucleus c. cytoplasm
b. cell wall d. mitochondrion

11) The ……. surrounds the cytoplasm and controls the substances that enter or leave the cell.

a. cell wall c. plasma membrane
b. nucleus d. mitochondrion

## ***Put (√) or (x):***

1- The number of cells in plants and animals varies from a species to another. ( )

2- A stomach consists of a group of tissues. ( )

3- The liver is a tissue, while the heart is an organ. ( )

4- The respiratory system consists of a set of cells. ( )

5- The cell is the smallest building unit of a living organism. ( )

6- Both the mitochondrion and plasma membrane are found in plant and animal cells. ( )

7- The cell membrane surrounds the plant cell from outside. ( )

8- Nucleus, mitochondria and cell membrane float in the cytoplasm. ( )

9- The outermost layer of the cell is called "cell membrane". ( )

## ***Write the scientific term:***

1. It is a structure inside the cell that has a specific function. ( …….. )
2. It is a set of tissues forming a structural unit to perform a specific function. ( …… )
3. It is a group of identical cells that perform the same function. ( …… )
4. It is a group of organs that perform a specific function. ( …… )
5. It's a liquid in which the cell's organelles float. ( …… )
6. It's a feature through which the cell membrane determines which substances will pass through. ( …….. )
7. It's the outer lining of the cell that surrounds the cytoplasm. ( …… )
8. It's the structure that controls the cell activities. ( …… )
9. They are the powerhouses of energy in the cell.

( …….. )

10. It's a process of using oxygen to get chemical energy from food in the cell. ( …….. )

## ***Complete the following sentences using the words between the brackets:***

**( cells - similar - nucleus - organelles – tissues )**

1) A cell consists of …… that are functioning in …… ways to maintain the cell.
2) An organ is composed of a set of …….. that are composed of a group of ……..
3) The …… in the cell is responsible for cell division.

## ***Correct the underlined words:***

A) A system is composed of a set of **tissues** that work together.

( …….. )

B) The stomach and lung are considered **systems**.

( …… )

C) The liver consists of a group of **organelles**.

( …… )

D) The **cytoplasm** is the control center of the cell.

( …….. )

E) The **cell wall** is a semi-permeable membrane that controls the substances entering the cell.

( …… )

F) **Photosynthesis process** takes place inside the mitochondria.

( …… )

G) The **plant** cell is the building unit of the human body.

( …… )

## *Cross out the odd word:*

- Cell membrane - Cell wall - Nucleus – Cytoplasm
- Digestive system - Respiratory system - Circulatory system - Heart
- Blood cell - Stomach - Lung - Liver

## *Choose from column (A) what suits it in column (B):*

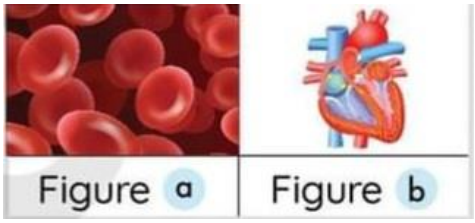
| Column (A) | Column (B) |
|---|---|
| 1- Nucleus<br>2- Cell membrane<br>3- Cell wall | a- is the control center of the cell.<br>b- supports the plant cell from outside.<br>c- controls the substances passing into or out of the cell. |

## ***Answer the following questions:***

***Study the following three figures, then answer:***

A) Figure (  ) consists of tissues.

B) Figure (  ) represents a group of cells.




**The following diagram represents the** ……

***Write the following labels:***

a) ……..

b) ……..

c) ……..

d) ……..


## ***Give reasons for:***

❖ All organs of the digestive system work together.

……

……

❖ The cell membrane has the selective permeability property.

……

……

❖ The nucleus has an important role for the cell.

……

……

❖ The mitochondrion has an important role for the cell.

……

……

## ***What happens if:***

1) The cell wall in the plant cell is absent.

……

……

2) The mitochondria are absent from an animal cell.

……

……

## ***Lesson 4***

## ***Choose the correct answer:***

1. Which of the following is found in both plant and animal cells?
   a. Cell membrane
   b. Cell wall
   c. Large, water-filled vacuole
   d. Chloroplast

2. Which two organelles are involved in transportation?
   a. Nucleus and endoplasmic reticulum
   b. Mitochondria and nucleus
   c. Chloroplast and Golgi apparatus
   d. Endoplasmic reticulum and Golgi apparatus

3. Photosynthesis process takes place in the …… while cellular respiration takes place in the ……..
   a. nucleus – cytoplasm
   b. mitochondria – nucleus
   c. mitochondria – chloroplast
   d. chloroplast - mitochondria

4. ……. are unique structures that exist only in the plant cell.
   a. Mitochondria b. Nuclei c. Vacuoles d. Chloroplasts

5. The plant cell is distinguished from the animal cell by the presence of …… and …….
   a. chloroplasts - nucleus
   b. nucleus - cell wall
   c. chloroplasts - cell wall
   d. nucleus - cytoplasm

6. The ……. release(s) energy to power the cell.
   a. Mitochondria
   b. cell wall
   c. nucleus
   d. cell membrane

7. ……. is the command center of the cell.
   a. Chloroplast c. Nucleus
   b. Mitochondrion d. Cell membrane

8. All the following can be stored in the cell vacuole, except ……..
   a. waste b. cytoplasm c. water d. nutrients

9. The …….. transports proteins in the cell.
   a. golgi apparatus c. endoplasmic reticulum
   b. Mitochondrion d. nucleus

10. The …… controls the substances that enter or leave the cell.
   a. cytoplasm b. cell wall c. nucleus d. cell membrane

11. The envelopes of the cell used for transporting materials are the …….
   a. nuclei c. mitochondria
   b. chloroplasts d. Golgi bodies

12. The …… in the cell resembles the powerful brick wall of a city.
   a. Nucleus b. cell wall c. cytoplasm d. cell membrane

13. Golgi apparatus can …… inside the cell.
   a. transport protein c. makes proteins
   b. package waste d. a and b

## ***Put (√) or (x):***

1- Both plant and animal cells have common organelles to organize and maintain the cell. ( )

2- Chloroplasts release energy from the food, but mitochondria produce energy from the sunlight. ( )

3- Chloroplasts have yellow grains called chlorophyll pigment. ( )

4- The outermost layer of a plant cell is the cell wall, but the outermost layer in an animal cell is the cell membrane. ( )

5- The animal cell has a definite shape, while the plant cell has an indefinite shape. ( )

6- Golgi apparatus can transport materials inside cells, but it can't transport them outside them. ( )

7- The plant cell has a larger vacuole than that of the animal cell. ( )

8- The cell membrane looks like guards at the gates of a city. ( )

## ***Write the scientific term:***

1) They help plant and animal cells control, organize, and maintain the cell. ( …….. )

2) It controls the functions inside the cell and cell division. ( …… )

3) They are saclike organelles that store nutrients, water, and waste. ( …… )
4) It's the fluid found in the cell that holds its organelles. ( …….. )
5) They're organelles in the plant cell that convert light energy into sugar. ( …….. )
6) They're organelles in the plant cell that power the cell with energy. ( …….. )
7) It's a process that occurs inside the chloroplast. ( …… )
8) It's a process that occurs inside the mitochondria. ( …… )

***<u>Complete the following sentences using the words between the brackets:</u>***

**( Golgi apparatus - sugar - Mitochondria – chloroplasts – exoskeleton - chlorophyll - Bones - endoplasmic reticulum )**

- ……. support(s) the fish body shape, while a/an …….. supports that of insects.
- In the photosynthesis process, ……. absorb(s) sunlight, where ……. use(s) it to make the plant's food.
- ……. transport(s) proteins produced by the ……. through the cell.

- …….. convert(s) …….. into energy that is needed for the cell activities.

## ***Correct the underlined words:***

- Chloroplasts have a green color due to the presence of **iodine** pigment. ( …… )
- A plant cell has a rigid shape due to the presence of the **cell membrane**. ( …… )
- Insects have a hard, shell-like support called **an endoskeleton**. ( …… )
- Cytoplasm is a **solid** matter that surrounds the cell's organelles. ( …… )
- The endoplasmic reticulum helps in the assembly and transport of **fats** in the cell. ( …… )
- **The endoplasmic reticulum** is the post office that packages proteins in the cell. ( …… )

## ***Cross out the odd word:***

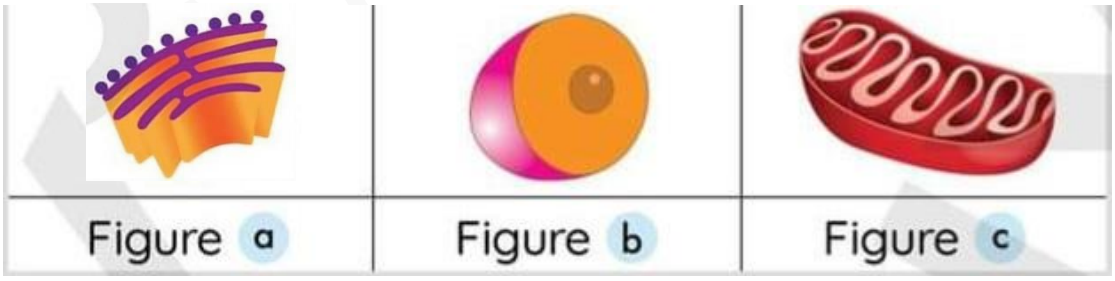
- Nucleus - Endoplasmic reticulum - Mitochondria - Chloroplasts
- Horses - Plants - Dogs – Insects

## ***Choose from column (A) what suits it in column (B):***

| Column (A) | Column (B) |
|---|---|
| 1. Mitochondrion<br>2. Golgi apparatus<br>3. Chloroplast<br>4. Vacuole<br>5. Endoplasmic reticulum<br>6. Nucleus | a) is the packaging factory for the cell.<br>b) is the food factory of the cell.<br>c) resembles the construction worker of a city.<br>d) is the powerhouse of the cell.<br>e) is considered the storage facility of the cell.<br>f) resembles the city hall that controls all the cell activities. |

## ***Answer the following questions:***

***Study the following three figures, then answer:***




- Figure (  ) converts sugar into energy.
- Figure (  ) is considered the protein maker in the cell.
- Figure (  ) helps in assembling and transporting proteins.

**The following diagrams represent the**

…….. and ……

***Write the following labels:***

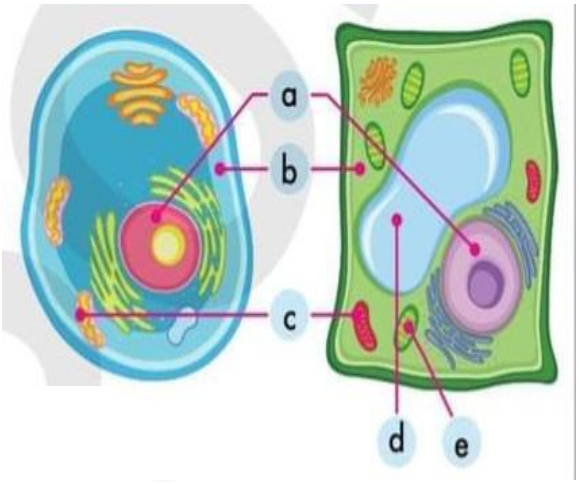
a) …….

b) …….

c) …….

d) …….

e) …….




***Mention the function of parts b and d***.

……

……..

## ***Give reasons for:***

- Both plant and animal cells have common organelles.

……

……

- Animals can't make their own food.

……

……

- Nucleus is the command center of the cell.

……

……

- The animal cell has an indefinite shape, but the plant cell has a definite shape.

……

……

- Animals can keep their shapes.

……

……

- The vacuole of the plant cell is larger than that of the animal cell.

……

……

- Mitochondria are considered the powerhouse of the cell.

……

……

- The Golgi apparatus resembles the post office of a city.

……

……

- The chloroplasts are the food factories of the cell.

……

……

- Endoplasmic reticulum has an important role in the cell.

……

……

## ***What happens if:***

1- Chloroplasts in a plant cell are damaged or functioning improperly.

……

……

2- Mitochondria stopped converting sugar into energy.

……

……

3- The endoplasmic reticulum is absent from the cell.

……

……

4- The Golgi apparatus is absent from the cell.

……

……

5- The plant has a small vacuole.

……

……

## ***Lesson 5 & 6***

## ***Choose the correct answer:***

1. Cell biologists use microscopes to magnify …… to appear larger.
   a. stones  b. bricks  c. cells  d. rocks

2. Cell biologists do experiments and analyze data to study all the following, except ……..
   a. how cells respond to different medicines.
   b. how rocks are formed on Earth's surface.
   c. how cells can work to repair body parts.
   d. how plant cells respond to different environmental factors.

3. To see the structure of a cell under microscope we must color it by using …….
   a. stains  b. water  c. sunlight  d. vinegar

4. Methylene blue dye helps us to see the …….. of the cell as a blue area under microscope.
   a. cytoplasm  c. chloroplast
   b. Golgi apparatus  d. nucleus

5. The 3D microscope can help in all the following, except that it helps ……..
    a. cell biologists learning more about cell components.
    b. scientists to know how planets revolve around the sun.
    c. doctors to treat some diseases as cancer.
    d. cell biologists learning more about how cells divide.

## ***Put (√) or (x):***

1) Cells are very large, as the diameter of an animal cell is about 0.001 cm. ( )
2) Cell biologists are scientists who study rocks. ( )
3) Cell biologists work in laboratories and do experiments to study how cells work inside living organisms. ( )
4) Cells are usually clear and colorless, so it is easy to see their structures under microscope. ( )
5) The 3D microscope can help doctors to treat cancer disease. ( )

## ***Write the scientific term of each of the following:***

1- They are scientists who study cells.
( …… )

2- A stain that is used to color the nucleus of the cell in blue color. ( …… )

3- The microscope that helps us to see the top, sides and layers of the cell. ( …… )

## ***Complete the following sentences using the words below:***

**( methylene blue - microscope – agriculture - cell biologists - doctors )**

A) Cell biologists use …… to magnify cells of bacteria.

B) Cell biologists work in …….. to study plant cells and their respond different environmental factors.

C) Cell biologists work with …… to watch how cells can work to repair the human body parts.

D) To see the nucleus of a cell under microscope, we can stain the cell with ……..

E) The 3D microscope can help …… learn more about how cells divide.

## ***Give reasons for:***

- Some cell biologists work with doctors.

…….

…….

- We must stain cells before examining them under microscope.

…….

…….

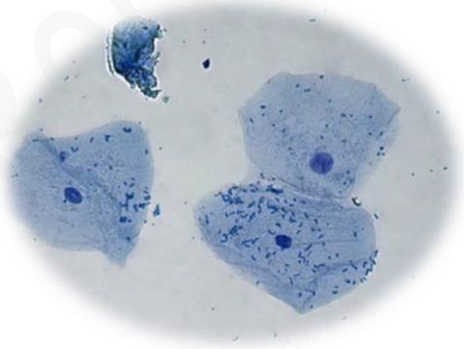
## ***What happens if…***

We stain a sample of cheek cells with methylene blue dye.

……

……

## ***Look at the opposite picture, then complete the following sentences:***



Cheek cells

1. These cells are seem large, because they are magnified by using ……
2. The structure of the cell which appears clearly with blue color in the opposite picture is the ……
3. These cells are stained by …….. dye.

## ***Look at the opposite picture, then answer the following questions: (A) Put (√) or (x):***

3D microscope

1. This device helps doctors to treat some diseases such as cancer. ( )
2. This device doesn't need a computer to do its functions. ( )
3. This device helps cell biologists to see the cells in 3D. ( )

***(B) Rearrange the following sentences in the right order to show how this device works:***

- A computer puts these layers together. (  )
- Colors are added to the formed image. (  )
- It takes pictures of a cell in layers. (  )

# Unit 1 – concept 1 – answers

## *Lesson 1*

### *Choose the correct answer:*

1) The …… is the building unit of a living organism's body.
   a. brick  b. cell  c. organ  d. blood

2) Humans are …….. organisms.
   a. unicellular  c. multicellular
   b. prokaryote  d. simple

3) An unaided human eye can see an object …… millimeters long.
   a. 0.01  b. 0.005  c. 0.5  d. 0.001

4) An unaided human eye can't see all the following, except ……..
   a. an onion's cell  c. a bacterial cell
   b. a skin's cell  d. a bird's unfertilized egg cell

5) A living organism grows and reproduces by increasing the ……. of its body cells.
   a. number  b. size  c. volume  d. length

6) All the following are multicellular living organisms, except ……..
   a. a bean plant  b. a cat  c. bacteria  d. a human

7) All the following are from the basic needs for the cell, except …….
   a. Water  b. oxygen  c. food  d. carbon dioxide

8) The …… regulates the substances that pass in or out of the cell.

a. Nucleus
c. cell wall
b. plasma membrane
d. cytoplasm

9) Which statement about the cells is false?

a. All living organisms are composed of cells.
b. All cells come from existing cells.
c. Most cells are microscopic in size.
d. All cells have a nucleus.

## ***Put (√) or (X):***

1- Most cells are usually very small. ( √ )
2- The unaided human eye can see a bacteria cell. ( X )
3- Different living organisms have similar cells that have similar functions. ( X )
4- Increasing the number of the living organism's cells occurs during reproduction process only. ( √ )
5- The cell membrane allows water to enter the cell, but not to leave it. ( X )
6- There must be a water imbalance at the two sides of the cell membrane, so that the cell won't burst. ( X )
7- The cell membrane allows only the needed substances to enter the cell. ( √ )
8- Scientists can use a telescope to see the very small cells. ( X )
9- An unfertilized bird egg contains more than one egg cell. ( X )
10- Multicellular organisms consist of only one single cell, such as the plant cell. ( X )

## ***Write the scientific term:***

1. They are the building units of life on Earth. ( **cells** )
2. They are living organisms, and their bodies consist of more than one cell. ( **multicellular organisms** )
3. They are living organisms, and their bodies consist of only one cell. ( **unicellular organisms** )
4. It's a device used to see very small cells as a plant cell. ( **microscope** )
5. It controls the substances that enter or leave the cell. ( **cell membrane** )
6. It's a gas which the cell needs to get energy and perform its vital activities. ( **oxygen gas** )
7. They're materials released from the cell. ( **waste products** )
8. It's a liquid material that is necessary for the cell to do its function well. ( **water** )

## ***Complete the following sentences using the words between the brackets:***

( **nucleus - shape – oxygen - energy - cell membrane – size – waste products – food**)

1) Cells in our body are different in **size** and **shape** because they have different functions.
2) All cells are composed of a **cell membrane**.
3) A cell takes in **oxygen** and **food** to get **energy** but it releases **waste products**.
4) Not all cells contain **nucleus**.

## ***Correct the underlined words:***

1- Most cells are very **large**, so we can see them with our naked eyes. ( **small** )
2- A cell is a **simple** structure that carries out its vital activities. ( **complex** )

3- Bacteria are **multicellular** living organisms.
( **unicellular** )

4- Living organisms can be divided into multicellular and unicellular organisms according to the **size** of cells in their bodies. ( **number** )

5- The cell will **shrink** when too much water keeps entering it.
( **swell** )

## *Cross out the odd word:*

a) Plant - **Bacteria** - Animal - Human

b) A skin cell - A plant cell - An animal's cell - **A bird's unfertilized egg cell**

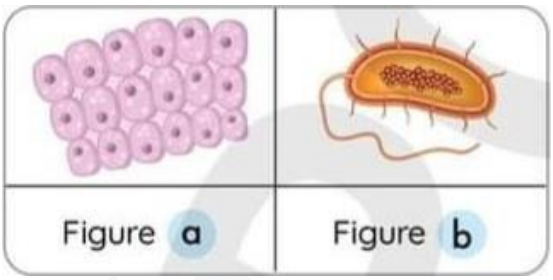
c) Oxygen - Water - **Carbon dioxide** - Food

## *Choose from column (A) what suits it in column (B):*

| Column (A) | Column (B) |
|---|---|
| 1. A cell membrane **c** | a. is smaller than 0.005 mm long. |
| 2. A bird's unfertilized egg cell **d** | b. length ranges between 0.005 to 0.1 mm. |
| 3. Bacterium **a** | c. controls the amount of water that enters the cell. |
| 4. A skin cell **b** | d. is a very large cell. |

## ***Study the following figures, then complete the sentences below:***

1) Figure **b** represents a bacterial cell, as it consists of **only one** cell(s).
2) Figure **a** represents the cells of a human skin.




## ***Give reasons for:***

1. The cell provides the structure of the living organism's body.
   - Because it's the building blocks of living organisms.

2. A plant is considered a multicellular organism.
   - Because they are organisms that have more than one cell.

3. Bacteria are considered unicellular organisms.
   - Because they are organisms made up of only one cell.

4. You can see a bird's unfertilized egg, but you can't see your skin cell without a microscope.
   - Because the unfertilized bird egg contains only one egg cell and it's very large, but the skin cell is very small and we need microscope to see it.

5. The cell membrane is very important for the cell.
   - Because it regulates which substances can enter or leave the cell.

6. The cells of the same living organisms are different in shape and size.
    - Because they have different functions.

7. The amount of water must be balanced at the two sides of the cell membrane.
    - Because if too much water enters the cell, the cell will swell until it bursts.

## ***What happens if:***

1- The cell can't get its basic needs.
    - The cell will not get energy and grow so it will die.

2- The cell membrane is absent in an animal cell.
    - There will be imbalance in leaving or entering the substances.

3- Too much water enters the cell.
    - The cell will swell until it bursts.

## ***Lesson 2***

## ***Choose the correct answer:***

1) …… was the first scientist to use the word "cell".
a. Newton **b. Hooke** c. Edison d. Einstein

2) The nucleus was discovered during an observation of an enormous …… cell.
a. animal b. bacterial c. human **d. plant**

3) Scientists concluded that the …….. is the basic unit of the organism's structure.
**a. cell** b. organ c. tissue d. system

4) All the following are form the parts of a compound microscope, except the ……..

a. eyepiece
b. objective lenses
c. illuminator
d. objective mirrors

5) The membrane of an onion consists of similar units called ……

a. cells
b. nuclei
c. organs
d. tissues

6) You can change the power of magnifying of a microscope by using another ……..

a. objective lens
b. eyepiece
c. mirror
d. arm

## ***Put (√) or (X):***

1. Developed microscopes have allowed scientists to make new discoveries. ( √ )
2. Sometimes a single cell exists on its own as in bacteria. ( √ )
3. The membrane of an onion consists of different units called cells. ( √ )
4. The cell in an onion membrane contains many components. ( √ )
5. A leaf cell and a red blood cell can exist in the same organism. ( X )
6. Scientists must be open to new ideas about how cells work. ( √ )

## ***Write the scientific term:***

1- It's a device that can be used to magnify cells.

( **microscope** )

2- They're the identical building units of living organisms.
( **cells** )

3- It's the type of water added on the samples in microscopes.
( **distilled water** )

4- It's a part of the microscope through which you look at the sample. ( **eyepiece** )

5- It's a part of the microscope that changes the magnifying power. ( **objective lens** )

## ***Correct the underlined words:***

I. A complex living system contains **one cell**.
( **more than one cell** )

II. We use drops of **tap** water on the sample in a microscope. ( **distilled** )

III. We look at the sample through the **objective lens** of the microscope. ( **eyepiece** )

IV. We change the magnifying power of the microscope by using a different **mirror**. ( **objective lens** )

## ***Cross out the odd word:***

- Objective lens - Stage clips - Eyepiece - **Distilled water**
- A leaf cell - A red blood cell - A skin cell - **A bird's unfertilized egg cell**

## *Choose from column (A) what suits it in column (B):*

| Column (A) | Column (B) |
|---|---|
| 1) The cell **b**<br>2) A compound microscope **c**<br>3) Changing the objective lens **a** | a) changes the magnifying power of the microscope.<br>b) is the building unit of the living organism's structure.<br>c) can be used to examine a thin membrane of an onion. |

## *Answer the following questions:*

**Study the following three figures that represent the samples under a compound microscope, then put true or false:**

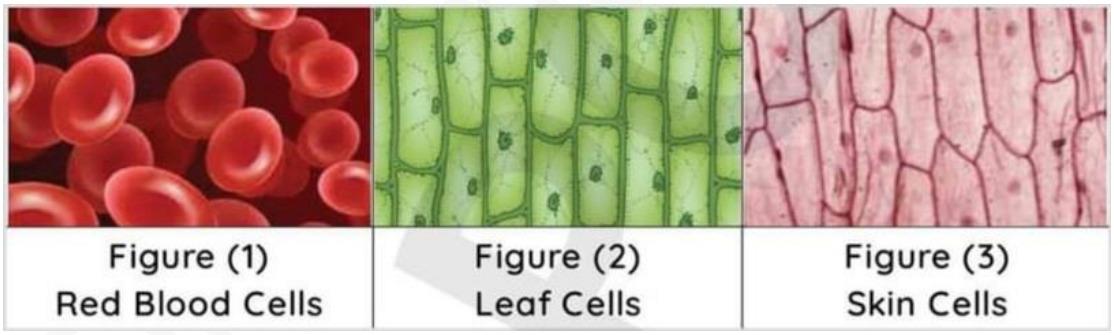
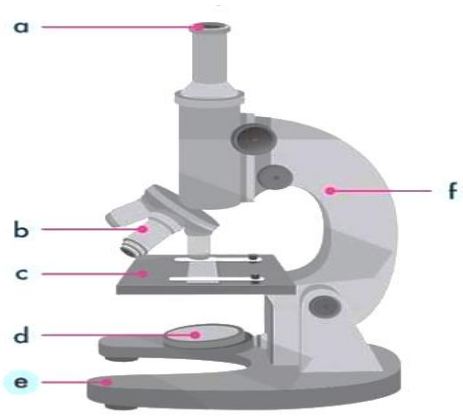


Figure (1) Red Blood Cells | Figure (2) Leaf Cells | Figure (3) Skin Cells

1. All the three samples represent microscopic cells. ( √ )
2. The three samples have different functions. ( √ )
3. All the three samples can exist in the same organism. ( X )
4. Each figure represents the basic units that form an organism. ( √ )

**The following diagram represents the structure of compound microscope.**

**Write the following labels:**




**a)** Eyepiece
**b)** Objective lenses
**c)** Stage
**d)** illuminator
**e)** Base

## ***Give a reason for:***

The microscope is very important for the biologists and botanists.

- To be able to look at small things in more details.

## ***What happens if:***

The microscope wasn't invented.

- Scientists would not be able to discover the cell and its structure.

## ***Lesson 3***

## ***Choose the correct answer:***

1) The human body is composed of …… cells.
   a. 40 hundred  b. 40 thousand  c. 40 million  **d. 40 trillion**

2) All the following are from the cells found in the animal body, except the ……
   a. blood cells  c. bone cells
   **b. xylem cells**  d. muscle cells

3) A/An …… is a unicellular simple living organism.
   a. human  b. animal  **c. bacterium**  d. plant

4) The tissue is a set of similar ……
a. systems b. cells c. organs d. organelles

5) All the following are considered organs, except the ……..
a. lung b. heart c. stomach d. muscle tissue

6) The systems that keep a multicellular organism alive are divided into …… levels.
a. two b. three c. four d. five

7) All the following organelles are common in plants and animals cells, except the ……
a. cytoplasm c. nucleus
b. cell wall d. cell membrane

8) Cell's components are suspended in the ……..
a. Nucleus c. cytoplasm
b. cell wall d. cell membrane

9) The ……. surrounds the plant cell from outside and gives it a definite shape.
a. Nucleus c. cytoplasm
b. cell wall d. cell membrane

10) The ……. is a liquid that fills the cavity of the cell and is surrounded by the cell membrane.
a. Nucleus c. cytoplasm
b. cell wall d. mitochondrion

11) The ……. surrounds the cytoplasm and controls the substances that enter or leave the cell.
a. cell wall c. plasma membrane

b. nucleus d. mitochondrion

## ***Put (√) or (x):***

1- The number of cells in plants and animals varies from a species to another. ( **√** )
2- A stomach consists of a group of tissues. ( **√** )
3- The liver is a tissue, while the heart is an organ. ( **X** )
4- The respiratory system consists of a set of cells. ( **X** )
5- The cell is the smallest building unit of a living organism. ( **√** )
6- Both the mitochondrion and plasma membrane are found in plant and animal cells. ( **√** )
7- The cell membrane surrounds the plant cell from outside. ( **√** )
8- Nucleus, mitochondria and cell membrane float in the cytoplasm. ( **X** )
9- The outermost layer of the cell is called "cell membrane". ( **√** )

## ***Write the scientific term:***

1. It is a structure inside the cell that has a specific function. ( **organelle** )
2. It is a set of tissues forming a structural unit to perform a specific function. ( **organ** )
3. It is a group of identical cells that perform the same function. ( **tissue** )
4. It is a group of organs that perform a specific function. ( **system** )
5. It's a liquid in which the cell's organelles float. ( **cytoplasm** )
6. It's a feature through which the cell membrane determines which substances will pass through. ( **selective permeability** )

7. It's the outer lining of the cell that surrounds the cytoplasm.
( **cell membrane** )
8. It's the structure that controls the cell activities.
( **nucleus** )
9. They are the powerhouses of energy in the cell.
( **mitochondria** )
10. It's a process of using oxygen to get chemical energy from food in the cell. ( **cellular respiration** )

## ***Complete the following sentences using the words between the brackets:***

**( cells - similar - nucleus - organelles – tissues )**

1) A cell consists of **organelles** that are functioning in **similar** ways to maintain the cell.
2) An organ is composed of a set of **tissues** that are composed of a group of **cells**.
3) The **nucleus** in the cell is responsible for cell division.

## ***Correct the underlined words:***

A) A system is composed of a set of **tissues** that work together.
( **organs** )
B) The stomach and lung are considered **systems**.
( **organs** )
C) The liver consists of a group of **organelles**.
( **tissues** )
D) The **cytoplasm** is the control center of the cell.
( **nucleus** )
E) The **cell wall** is a semi-permeable membrane that controls the substances entering the cell.
( **cell membrane** )
F) **Photosynthesis process** takes place inside the mitochondria.
( **cellular respiration** )

G) The **plant** cell is the building unit of the human body.
( **animal** )

## *Cross out the odd word:*

- Cell membrane - **Cell wall** - Nucleus – Cytoplasm
- Digestive system - Respiratory system - Circulatory system - **Heart**
- **Blood cell** - Stomach - Lung - Liver

## *Choose from column (A) what suits it in column (B):*

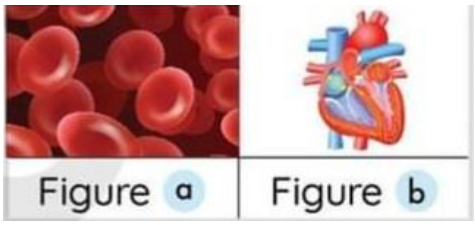
| Column (A) | Column (B) |
|---|---|
| 1- Nucleus **a**<br>2- Cell membrane **c**<br>3- Cell wall **b** | a- is the control center of the cell.<br>b- supports the plant cell from outside.<br>c- controls the substances passing into or out of the cell. |

## *Answer the following questions:*

***Study the following three figures, then answer:***

A) Figure ( **b** ) consists of tissues.

B) Figure ( **a** ) represents a group of cells.



**The following diagram represents the structure of animal cell.**

***Write the following labels:***


a) Nucleus
b) Mitochondria
c) Cytoplasm
d) Cell membrane

## ***Give reasons for:***

❖ All organs of the digestive system work together.
- Because each organ performs a specific function to form the digestive system.

❖ The cell membrane has the selective permeability property.
- Because some substances can pass through it, while others can't.

❖ The nucleus has an important role for the cell.
- Because it's responsible for controlling cell activities such as making proteins and cell division.

❖ The mitochondrion has an important role for the cell.
- Because they are powerhouses that supply the cell with energy, and cellular respiration takes place in it.

## ***What happens if:***

1) The cell wall in the plant cell is absent.
   - The plant cell will have indefinite shape.

2) The mitochondria are absent from an animal cell.
   - The cell will not supply with energy and cellular respiration doesn't take place.

## *Lesson 4*

## *Choose the correct answer:*

1. Which of the following is found in both plant and animal cells?
   a. Cell membrane
   b. Cell wall
   c. Large, water-filled vacuole
   d. Chloroplast

2. Which two organelles are involved in transportation?
   a. Nucleus and endoplasmic reticulum
   b. Mitochondria and nucleus
   c. Chloroplast and Golgi apparatus
   d. Endoplasmic reticulum and Golgi apparatus

3. Photosynthesis process takes place in the …… while cellular respiration takes place in the ……..
   a. nucleus – cytoplasm
   b. mitochondria – nucleus
   c. mitochondria – chloroplast
   d. chloroplast - mitochondria

4. …… are unique structures that exist only in the plant cell.
   a. Mitochondria b. Nuclei c. Vacuoles d. Chloroplasts

5. The plant cell is distinguished from the animal cell by the presence of …… and ……..
   a. chloroplasts - nucleus
   b. nucleus - cell wall
   c. chloroplasts - cell wall
   d. nucleus - cytoplasm

6. The …… release(s) energy to power the cell.
   a. Mitochondria
   b. cell wall
   c. nucleus
   d. cell membrane

7. …… is the command center of the cell.

a. Chloroplast c. Nucleus
b. Mitochondrion d. Cell membrane

8. All the following can be stored in the cell vacuole, except ……..
a. waste b. cytoplasm c. water d. nutrients

9. The …….. transports proteins in the cell.
a. Golgi apparatus c. endoplasmic reticulum
b. Mitochondrion d. nucleus

10. The …… controls the substances that enter or leave the cell.
a. cytoplasm b. cell wall c. nucleus d. cell membrane

11. The envelopes of the cell used for transporting materials are the ……..
a. nuclei c. mitochondria
b. chloroplasts d. Golgi bodies

12. The …… in the cell resembles the powerful brick wall of a city.
a. Nucleus b. cell wall c. cytoplasm d. cell membrane

13. Golgi apparatus can …… inside the cell.
a. transport protein c. makes proteins
b. package waste d. a and b

## ***Put (√) or (x):***

1- Both plant and animal cells have common organelles to organize and maintain the cell. ( √ )

2- Chloroplasts release energy from the food, but mitochondria produce energy from the sunlight. ( **X** )
3- Chloroplasts have yellow grains called chlorophyll pigment. ( **X** )
4- The outermost layer of a plant cell is the cell wall, but the outermost layer in an animal cell is the cell membrane. ( **√** )
5- The animal cell has a definite shape, while the plant cell has an indefinite shape. ( **X** )
6- Golgi apparatus can transport materials inside cells, but it can't transport them outside them. ( **X** )
7- The plant cell has a larger vacuole than that of the animal cell. ( **√** )
8- The cell membrane looks like guards at the gates of a city. ( **√** )

## ***Write the scientific term:***

1) They help plant and animal cells control, organize, and maintain the cell. ( **Organelles** )
2) It controls the functions inside the cell and cell division. ( **Nucleus** )
3) They are saclike organelles that store nutrients, water, and waste. ( **Vacuole** )
4) It's the fluid found in the cell that holds its organelles. ( **Cytoplasm** )
5) They're organelles in the plant cell that convert light energy into sugar. ( **Chloroplast** )
6) They're organelles in the plant cell that power the cell with energy. ( **Mitochondria** )
7) It's a process that occurs inside the chloroplast. ( **Photosynthesis process** )
8) It's a process that occurs inside the mitochondria. ( **Cellular respiration** )

## ***Complete the following sentences using the words between the brackets:***

**( Golgi apparatus - sugar - Mitochondria – chloroplasts – exoskeleton - chlorophyll - Bones - endoplasmic reticulum )**

- **Bones** support(s) the fish body shape, while a/an **exoskeleton** supports that of insects.
- In the photosynthesis process, **chlorophyll** absorb(s) sunlight, where **chloroplasts** use(s) it to make the plant's food.
- **Endoplasmic reticulum** transport(s) proteins produced by the **Golgi apparatus** through the cell.
- **Mitochondria** convert(s) **sugar** into energy that is needed for the cell activities.

## ***Correct the underlined words:***

- Chloroplasts have a green color due to the presence of **iodine** pigment. ( **chlorophyll** )
- A plant cell has a rigid shape due to the presence of the **cell membrane**. ( **cell wall** )
- Insects have a hard, shell-like support called **an endoskeleton**. ( **exoskeleton** )
- Cytoplasm is a **solid** matter that surrounds the cell's organelles. ( **liquid** )
- The endoplasmic reticulum helps in the assembly and transport of **fats** in the cell. ( **proteins** )
- **The endoplasmic reticulum** is the post office that packages proteins in the cell. ( **Golgi apparatus** )

## ***Cross out the odd word:***

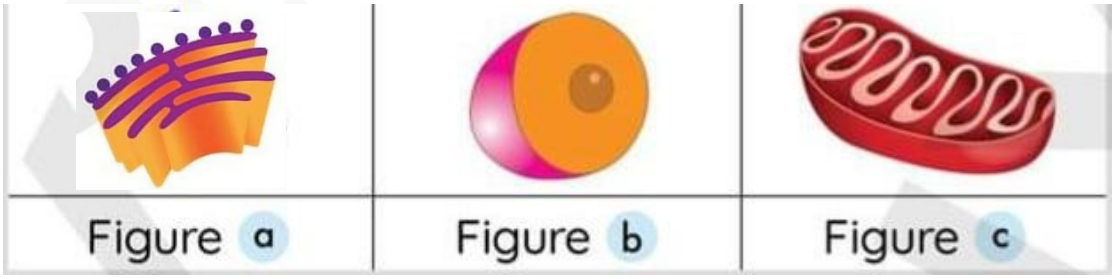
- Nucleus - Endoplasmic reticulum - Mitochondria - **Chloroplasts**
- Horses - **Plants** - Dogs – Insects

## ***Choose from column (A) what suits it in column (B):***

| Column (A) | Column (B) |
|---|---|
| 1. Mitochondrion **d**<br>2. Golgi apparatus **a**<br>3. Chloroplast **b**<br>4. Vacuole **e**<br>5. Endoplasmic reticulum **c**<br>6. Nucleus **f** | a) is the packaging factory for the cell.<br>b) is the food factory of the cell.<br>c) resembles the construction worker of a city.<br>d) is the powerhouse of the cell.<br>e) is considered the storage facility of the cell.<br>f) resembles the city hall that controls all the cell activities. |

## ***Answer the following questions:***

***Study the following three figures, then answer:***

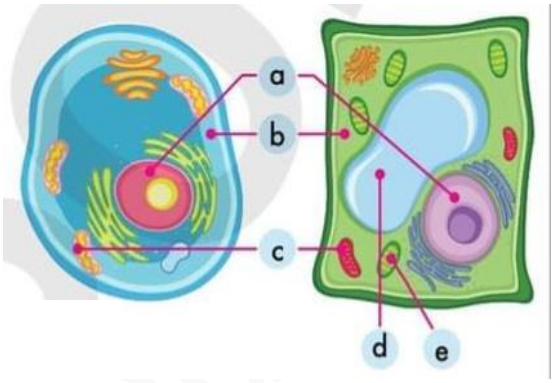



- Figure ( **c** ) converts sugar into energy.
- Figure ( **b** ) is considered the protein maker in the cell.
- Figure ( **a** ) helps in assembling and transporting proteins.

**The following diagrams represent the structure of plant cell and animal cell**

***Write the following labels:***

a) Nucleus
b) Cytoplasm
c) Mitochondria
d) Vacuole
e) Chloroplasts




***Mention the function of parts b and d.***

Part b (cytoplasm): it's the gelatinous liquid inside the cells in which other cell parts float.
Part d (Vacuole): it is used for the storage of nutrients, water and waste.

## ***Give reasons for:***

- Both plant and animal cells have common organelles.
  - Because both of them have cell membrane, cytoplasm, nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, and vacuole.

- Animals can't make their own food.
  - Because they don't have chloroplasts.

- Nucleus is the command center of the cell.
  - Because it controls the functions inside the cell such as: making proteins and cell division.

- The animal cell has an indefinite shape, but the plant cell has a definite shape.
  - Because the animal cell doesn't have cell wall, but the plant cell has rigid cell wall.

- Animals can keep their shapes.
  - Because some animals have bones, and insects have an exoskeleton.

- The vacuole of the plant cell is larger than that of the animal cell.
  - Because the plant stores a large amount of water in the vacuole.

- Mitochondria are considered the powerhouse of the cell.
  - Because it converts sugar into energy for the cell.

- The Golgi apparatus resembles the post office of a city.
  - Because it helps package nutrients within vital products inside the cell and it helps transport nutrients outside the cell.

- The chloroplasts are the food factories of the cell.
  - Because they contain chlorophyll and carry out the photosynthesis process.

- Endoplasmic reticulum has an important role in the cell.
  - Because it helps in assembling and transporting proteins.

## ***What happens if:***

1- Chloroplasts in a plant cell are damaged or functioning improperly.

- The plant will not be able to absorb energy from sunlight to make its own food.

2- Mitochondria stopped converting sugar into energy.

- The cell will not supply with energy and cellular respiration doesn't take place.

3- The endoplasmic reticulum is absent from the cell.

- The cell will not be able to assemble and transport proteins.

4- The Golgi apparatus is absent from the cell.

- The nutrients will not transport outside the cell, and they will not be packaged within vital products inside the cell.

5- The plant has a small vacuole.

- The plant will not be able to store a large amount of water, nutrients and wastes.

## ***Lesson 5 & 6***

## ***Choose the correct answer:***

1. Cell biologists use microscopes to magnify …… to appear larger.

   a. stones  b. bricks  c. cells  d. rocks

2. Cell biologists do experiments and analyze data to study all the following, except ……..

a. how cells respond to different medicines.
b. how rocks are formed on Earth's surface.
c. how cells can work to repair body parts.
d. how plant cells respond to different environmental factors.

3. To see the structure of a cell under microscope we must color it by using …….
   a. stains  b. water  c. sunlight  d. vinegar

4. Methylene blue dye helps us to see the ……. of the cell as a blue area under microscope.
   a. cytoplasm  c. chloroplast
   b. Golgi apparatus  d. nucleus

5. The 3D microscope can help in all the following, except that it helps ……..
   a. cell biologists learning more about cell components.
   b. scientists to know how planets revolve around the sun.
   c. doctors to treat some diseases as cancer.
   d. cell biologists learning more about how cells divide.

***Put (√) or (x):***

1) Cells are very large, as the diameter of an animal cell is about 0.001 cm. ( X )
2) Cell biologists are scientists who study rocks. ( X )
3) Cell biologists work in laboratories and do experiments to study how cells work inside living organisms. ( √ )
4) Cells are usually clear and colorless, so it is easy to see their structures under microscope. ( X )
5) The 3D microscope can help doctors to treat cancer disease. ( √ )

## ***Write the scientific term of each of the following:***

1- They are scientists who study cells. ( **cell biologists** )
2- A stain that is used to color the nucleus of the cell in blue color. ( **methylene blue** )
3- The microscope that helps us to see the top, sides and layers of the cell. ( **3D microscope** )

## ***Complete the following sentences using the words below:***

**( methylene blue - microscope – agriculture - cell biologists - doctors )**

A) Cell biologists use **microscope** to magnify cells of bacteria.
B) Cell biologists work in **agriculture** to study plant cells and their respond different environmental factors.
C) Cell biologists work with **doctors** to watch how cells can work to repair the human body parts.
D) To see the nucleus of a cell under microscope, we can stain the cell with **methylene blue**.
E) The 3D microscope can help **cell biologists** learn more about how cells divide.

## ***Give reasons for:***

- Some cell biologists work with doctors.
  - **To watch how cells can work to repair the human body parts.**

- We must stain cells before examining them under microscope.
  - **Because the cells are usually clear and colorless and to make their structures more visible.**

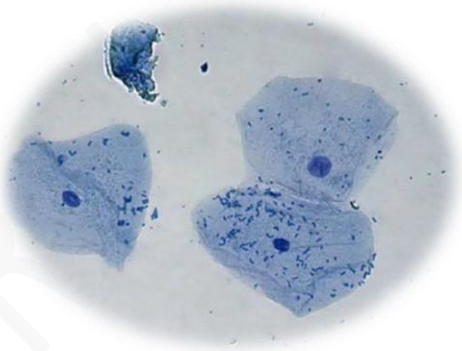
## ***What happens if…***

We stain a sample of cheek cells with methylene blue dye.

- **We will see the nucleus as a blue area.**

## ***Look at the opposite picture, then complete the following sentences:***

1. These cells are seem large, because they are magnified by using **microscope**.
2. The structure of the cell which appears clearly with blue color in the opposite picture is the **nucleus**.



Cheek cells

3. These cells are stained by **methylene blue** dye.

## ***Look at the opposite picture, then answer the following questions: (A) Put (√) or (x):***

1. This device helps doctors to treat some diseases such as cancer. ( **√** )
2. This device doesn't need a computer to do its functions. ( **X** )
3. This device helps cell biologists to see the cells in 3D. ( **√** )

3D microscope

***(B) Rearrange the following sentences in the right order to show how this device works:***

- A computer puts these layers together. ( **2** )
- Colors are added to the formed image. ( **3** )
- It takes pictures of a cell in layers. ( **1** )